

NOTE

Destruction of Marine Flora and Fauna in Fiji Caused by the Hurricane of February 1965¹

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EARLY IN FEBRUARY 1965 a hurricane passed close to the main islands of Fiji. This hurricane brought not only widespread flooding on Viti Levu, the largest island in the group, but also caused unexpected and severe damage to the coral reefs in the southern part of Mbau Water, on the east coast of Viti Levu.

Mr. P. R. Rakoroi, the Officer in Charge at the New Zealand Meteorological Service at Lauthala Bay, gave me the meteorological details and plotted the storm centre on the accompanying map (Fig. 1). The storm began as a small tropical depression to the west of Wallis Island and developed into a severe hurricane as it travelled southwest towards Fiji. The map shows the storm centre on February 7 to be almost stationary, but it was actually moving in a small clockwise circle over northwest Bligh Water before continuing its southwest movement. By February 8 the hurricane was travelling south-southwest, but much more slowly than is usual with these tropical storms. However, by February 9 it had at last picked up speed and begun to move southwest away from Viti Levu. Because the hurricane moved so slowly on the 7th and 8th, torrential rain which always accompanies these tropical storms fell on the island of Viti Levu for a far longer time than is normal. The rainfall figures for Koro-o,

the meteorological station high up on the Rewa watershed in north Viti Levu, and for the meteorological station at Laucala Bay on the coast in southeast Viti Levu, are as follows:

	KORO-O	LAUCALA BAY
	<i>inches</i>	<i>inches</i>
Feb. 6	1.56
7	11.87	1.78
8	31.09	8.25
9	6.79	3.56
10	0.36	0.14

Mr. J. R. Deverell, District Officer, Nausori, gave me details of the flooding caused by this heavy rain. The ground in the hills of the Rewa watershed was completely waterlogged by the 11 inches of rain which fell on February 7, so that the enormous quantity of water from the 31 inches which fell the next day simply poured straight off the hills into the creeks which are the start of the Rewa river system. As this mass of water flowed down to the Rewa River, the tributaries rose to alarming heights. In some gorges the water was up to 100 feet above normal. The Rewa itself at Nausori, where the river is very wide and there is a large flood plain, was 15 ft above normal at high tide, and the whole of Rewa delta was under water.

The main mouth of the Rewa, the Nukulau Mouth, is on the southwest side of the delta. The continuous flow of fresh-water from this mouth is sufficient to keep open a large passage through the barrier reef. This passage was able to carry off the extra water that came down the river during the storm before it caused any

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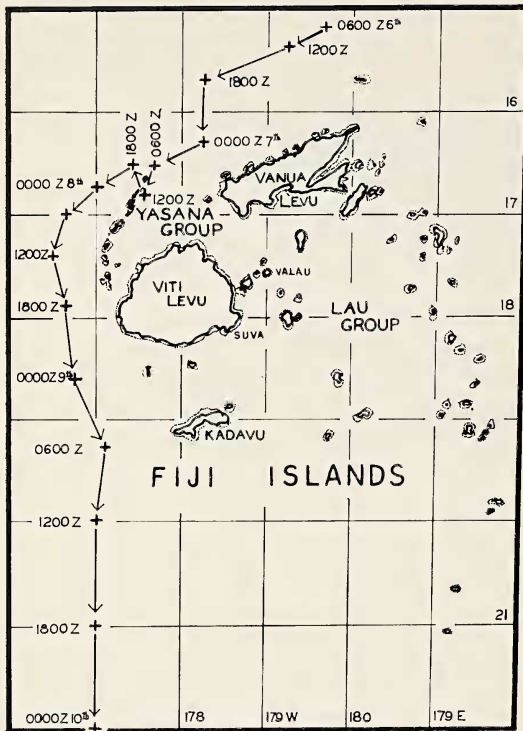


FIG. 1. Track of Hurricane, February 1965.

great damage to the coral reefs in that area. The Navulua Mouth, one of several minor mouths of the Rewa, is on the north side of the delta. This mouth runs into the south end of Mbau Water, a lagoon-like area bounded to the west by Viti Levu, to the south by the Kamba Peninsula, and the east by a large luxuriant coral reef; to the north it joins Bligh Water, northwest of Ovalau Island 25 miles away. The amount of fresh-water carried by the Navulua Mouth had not been sufficient to prevent the growth of corals in the area which abounded in fish, mollusks, turtles, and other marine life.

During the February floods the left bank of the Rewa River just below Wainibokasi village gave way, and a mass of floodwater poured into an old bed of the river and was carried northwest across the delta to flow into the sea through the Navulua Mouth as a great brown, muddy stream. This was seen from Colo-i-Suva, the highest point on the Suva peninsula, by

Sakanasa Rokotuidau and other officers of the Co-operatives Department, who described it as "a brown stain on the sea" which covered the south end of Mbau Water and stretched out into the ocean over the barrier reefs.

For some days after the floods a few dead fish, mostly parrot fish and wrasse, were found on the beaches round Laucala Bay, the Suva peninsula, and Lami. Fishermen reported finding dead fish off the Nasoata and Nasilai mouths of the Rewa, but it is not uncommon for a few dead fish and shells to be found after very heavy rain. However, on February 15 a report came in from Tomberua Island that the sea round the island was covered with thousands of dead fish. I made a trip down the Rewa to Tomberua Island on February 17 to see for myself the extent of the damage, and to talk about it with the people of Kamba village.

Mr. McHugh, owner of Tomberua Island, and the Kamba villagers told me about the dead fish. On February 13 and 14, while they were attempting to salvage a small cutter which had been wrecked on the outer reef during the storm, they passed many dead fish floating on the water. They said that the fish lay in long swathes in the hollows of the waves, 10 ft wide, several fish deep, and stretching as far as they could see. There were fish of all kinds, a few very large fish, most of which had been mauled; many hundreds of medium-sized fish, small barracudas, parrot fish, wrasse, red and grey snappers, groupers, eels, surgeon fish, mullets, puffer fish, and trigger fish; many thousands of very small fish, brilliantly coloured damsel fish and butterfly fish, small eels, and young fish of all kinds. On February 15 and 16 many of these fish were washed up on the beach at Tomberua, where they were buried, but very few were cast up on the beaches of the Kamba peninsula. The Kamba people, who are expert fishermen, told me that they had never heard of anything like this happening before. The floods of 1929, 1931, 1954, and March 1964, although causing heavy damage to property and food crops and mortality amongst livestock, did not affect any reefs to this extent.

I walked on the Tomberua reef at half tide

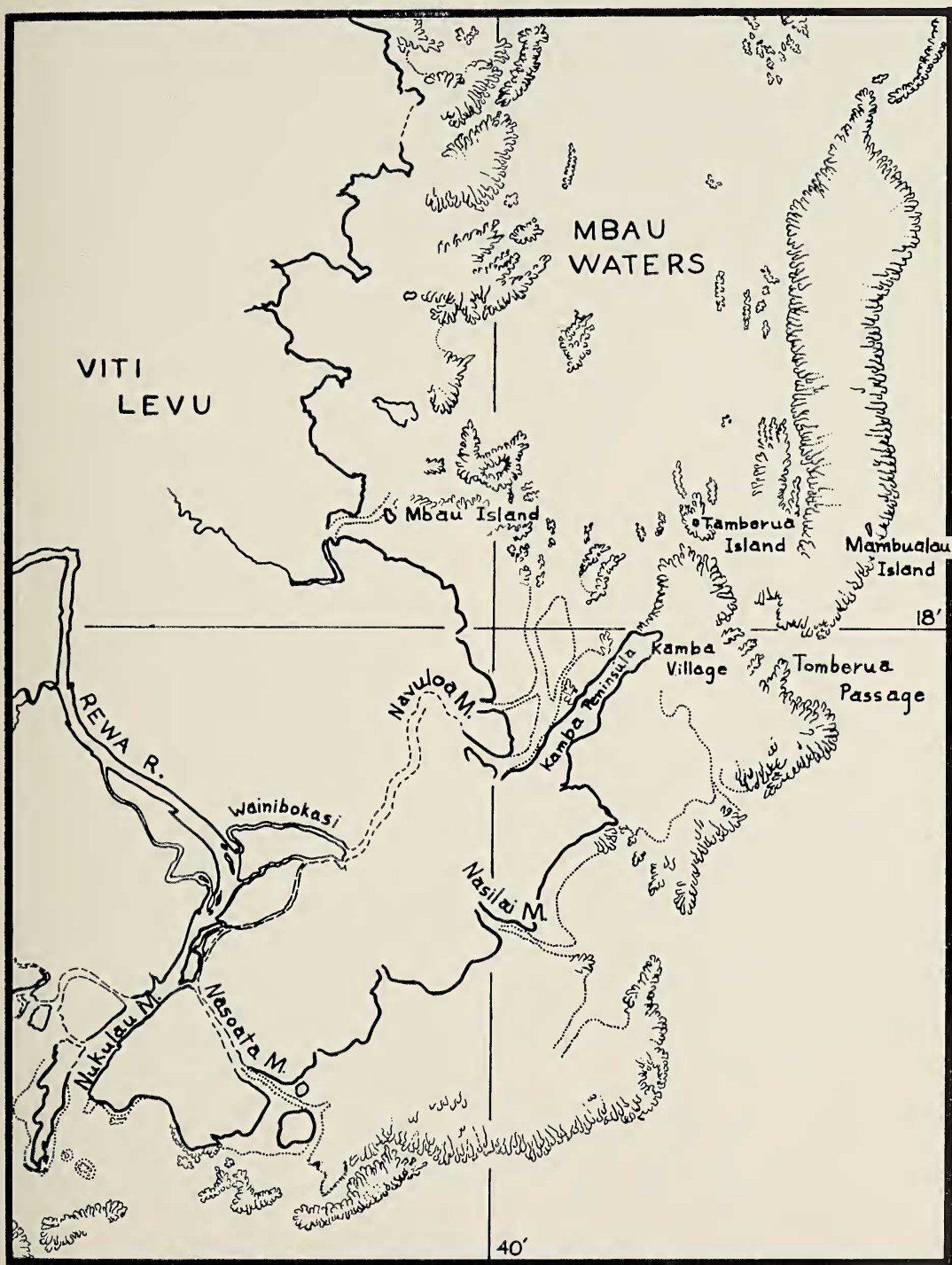


FIG. 2. Map of Mbaú Waters, Fiji.

and wandered slowly along the edge of the receding water. I stayed out on the reef until the tide turned and began to cover the reef again. Nearly every living thing, plant or animal, on the reef was dead. The reef itself was a dull brown, the sand a dull grey. In places there were patches of white or black, the putrefying remains of unidentifiable sea creatures. Shells of many kinds were lying on the sand, on what had presumably been a mat of green alga, now a yellowish-grey rotting mass. There were thorny oysters gaping white on the stones, there were cockles, clams, tellins, scallops, augurs, black-mouthed pinnas, pink olives, and the carapaces of sand dollars and heart urchins scattered everywhere, with foul-smelling clumps of rotting *Halimeda*. Farther out among the tide pools were many kinds of cones, miters, cowries, limpets, strombs, spider shells, and chitons, together with the fluorescent whiteness of burst and rotting holothurians. Some of the shells had already been occupied by a species of black and yellow hermit crab, but these crabs were very languid and obviously dying. I turned over a few stones: they were black and slimy underneath, a dying worm or two floated out, and the decaying remains of a brittle star. There were no small sponges, algae, anemones, shell eggs, or any other organisms left alive under the stones or in the sand, which was black and foul under the surface. On the very edge of the reef the smell was really horrible. There were large putrefying masses of soft corals, decaying remains of many unidentifiable creatures lying on the dull, brown, dead corals. I peered into the deeper water. Even the sea seemed to smell of decay, and I could see no sign of any coloured living coral nor the bright green of any alga. All seemed dead.

This dismal picture was relieved a little when I found a very lively, very belligerent red-eyed crab, and, in one or two of the deeper tide pools near the edge of the reef, I found that a few small fish had already moved in, or perhaps had survived the kill. They were very few in number and appeared to be a species of goby, one small *Pleisops*, and three species of *Abudefduf*, possibly *sordidus*, *zonatus*, and *sax-*

atilis. I noticed that these live fish were in pools that had a rock or clear sand bottom, with no rotting algae, and which possibly had a higher oxygen content than other pools. In one shallow pool I found a beautiful green and blue cowfish, *Lactoria* sp., which was grazing on rotting algae and appeared unaffected by the foul conditions. I saw several rather large eels, *Gymnothorax picta*, which were swimming with their heads sticking out of the water and seemed completely fearless. On my way back to the island I found several apparently healthy colonies of a species of *Nerita* and one small bright green tuft of *Enteromorpha* growing in a strong current near the edge of the reef. A frequent splashing sound attracted my attention and, wading out into the sea, I found it was caused by a huge school of sardines, or "dan-iva" (*Clupea* sp.?), frantically feeding on the cloudy brown detritus from the reef.

The Kamba people told me that during the flood the whole sea around Tomberua Island, off the Kamba peninsula, and right out over the reef by Mumbualau Island was muddy, and that when they swam in it they found that it was quite fresh, "like the river." It seems certain that this freshening of the water was responsible for the initial mortality. The Department of Agriculture says that there had been little or no use of pesticides or herbicides prior to the floods which might have been washed off the land into the rivers, nor does there seem to have been any other form of pollution which could have caused the damage. The many fish and other plants and animals killed by the fresh-water began to putrefy, and this in turn caused the death of other organisms by using up the available oxygen and polluting the reef with hydrogen sulphide and other products of decomposition.

It will be very interesting to watch the regeneration and repopulation of these reefs to see if there is any marked or permanent ecological change. In recent years some fish caught in Mbau Water have been known to cause ciguatera poisoning; these are chiefly *Lethrinus miniatus* and *Lutianus bohar*, although other lethrinids may be poisonous as well. Cases of

poisoning from fish caught there were rather infrequent but continual. According to one hypothesis, ciguatera increases when "new surfaces" are exposed to settlement by blue-green algae (Randall, 1958). As yet no cases of fish poisoning have been reported. The Kamba people, who traditionally fish in these waters, are most concerned in case the poisoning should become much worse as a result of the extensive damage and are watching the area with great interest.

REFERENCES

- COOPER, M. J. 1964. Ciguatera and other marine poisoning in the Gilbert Islands. *Pacific Science* 18(4):411-440.
- DERRICK, R. A. 1946. *A History of Fiji*. Vol. 1. Government Press, Suva.
- RANDALL, J. E. 1958. A review of ciguatera, tropical fish poisoning, with a tentative explanation of its cause. *Bull. Mar. Sci. Gulf and Carib.* 8(3):236-267.